FORM PTO-1390 (Modified) (REV 11-2000) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371	343-01
	U S APPLICATION NO (IF KNOWN, SEE 37 CFR) PCT/DE00/01928 10/019601

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/01928	June 9, 2000	July 6, 1999

TITLE OF INVENTION

A LONG-FIBRE REINFORCED THERMOPLASTICS MATERIAL AND A METHOD FOR PRODUCTION OF SAME

APPLICANT(S) FOR DO/EO/US

Mathias Lindner

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S C 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U S C 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C 371(f)). The submission must include items (5), (6), (9) and (24) indicated below
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31)
5. ☒ A copy of the International Application as filed (35 U.S C 371 (c) (2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau)
   b ☐ has been communicated by the International Bureau
   c ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ An English language translation of the International Application as filed (35 U.S.C 371(c)(2))
   a ☒ is attached hereto.
   b ☐ has been previously submitted under 35 U.S C 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S C 371 (c)(3))
   a ☐ are attached hereto (required only if not communicated by the International Bureau)
   b ☐ have been communicated by the International Bureau
   c ☐ have not been made, however, the time limit for making such amendments has NOT expired
   d. ☒ have not been made and will not be made
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U S.C. 371(c)(3))
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C 371 (c)(4)). (UNSIGNED)
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S C 371 (c)(5))
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409)
12. ☒ A copy of the International Search Report (PCT/ISA/210)

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1 97 and 1 98
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3 28 and 3 31 is included
15. ☒ A **FIRST** preliminary amendment
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter 2 and 35 U S C 1 821 - 1.825
20. ☐ A second copy of the published international application under 35 U S.C. 154(d)(4)
21. ☐ A second copy of the English language translation of the international application under 35 U S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☐ Other items or information

531 Rec'd PCT/PTO 27 DEC 2001

U.S. APPLICATION NO (IF KNOWN, SEE 37 CFR 1.5) 10/037210	INTERNATIONAL APPLICATION NO PCT/DE00/01928	ATTORNEY'S DOCKET NUMBER 343-01
PCT/DE00/01928		

24. The following fees are submitted:	CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		
☐ Neither international preliminary examination fee (37 CFR 1 482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO . . . **$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1 445(a)(2)) paid to USPTO . . . **$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**		
☐ International preliminary examination fee (37 CFR 1 482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) . **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e))	**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	26 - 20 =	6	x $18.00	**$108.00**	
Independent claims	2 - 3 =	0	x $84.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**			☒	**$280.00**	
TOTAL OF ABOVE CALCULATIONS =				**$1,278.00**	
☐ Applicant claims small entity status See 37 CFR 1 27) The fees indicated above are reduced by 1/2.				**$0.00**	
SUBTOTAL =				**$1,278.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1 492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$1,278.00**	
Fee for recording the enclosed assignment (37 CFR 1 21(h)) The assignment must be accompanied by an appropriate cover sheet (37 CFR 3 28, 3 31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$1,278.00**	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **$1,278.00** to cover the above fees is enclosed

b. ☐ Please charge my Deposit Account No _____ in the amount of _____ to cover the above fees A duplicate copy of this sheet is enclosed

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **16-0750** A duplicate copy of this sheet is enclosed

d. ☐ Fees are to be charged to a credit card **WARNING:** Information on this form may become public **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

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SIGNATURE

John F. McNulty, Esquire
NAME

23,028
REGISTRATION NUMBER

December 27, 2001
DATE

PATENT

IN THE UNITED STATES PATENT OFFICE

Serial No.: Not yet assigned

Filed: Herewith

For: **A LONG-FIBRE REINFORCED THERMOPLASTICS MATERIAL AND A METHOD FOR PRODUCTION OF SAME**

Inventor: **Mathias Lindner**

Atty Doc. No.: 343-01

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please amend the above-identified patent application as follows:

In the Claims:

Please amend the claims as follows:

claim 4 line 1, change "3" to –2--;

claim 5 line 1, change "4" to –2--;

claim 6 line 1, change "5" to –2--;

claim 7 line 1, change "6" to –2--;

claim 8 line 1, change "7" to –2--;

claim 9 line 1, change "8" to –2--;

claim 10 line 1, change "9" to –2--;

claim 15 line 1, delete "or claim 14".

REMARKS

The above amendments are made in order to eliminate multiple dependent claims that would otherwise be improperly dependent upon other multiple dependent claims and to place the claims in proper U.S. form. A revised set of claim pages incorporating the above changes are provided herewith.

Respectfully submitted,

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Replacement Pages 8-9

Claims

1. A long-fibre reinforced thermoplastics material, characterised in that the matrix of the material consists of at least two different thermoplastics, wherein the fibres are wetted essentially by only one of the two thermoplastics materials.

2. A material according to Claim 1, characterised in that one of the substances of which the matrix consists has a poor impregnation capability or wetting capability with respect to the fibres which are present in the material.

3. A material according to Claim 1 or Claim 2, characterised in that the fibres which are contained in the material consist of glass-, carbon-, aramide- or natural fibres, e.g. flax, hemp or jute, or mixtures of the afore-mentioned fibre materials.

4. A material according to one of Claims 1 to 2, characterised in that it contains a material which wets the fibres well, and which is selected from the group consisting of polypropylene, polyamide (polyamide 6, polyamide 66, polyamide 12, polyamide 46), polyethylene, acrylonitrile/butadiene/styrene-copolymers, polyphenylsulphide, polystyrene and polyether-ether ketone.

5. A material according to one of Claims 1 to 2, characterised in that the second thermoplastics substance does not wet the fibres directly or to a significant extent.

6. A material according to one of Claims 1 to 2, characterised in that the, at least two, thermoplastics materials contained therein are poorly miscible, or immiscible, and form an inhomogeneous mixture.

7. A material according to one of Claims 1 to 2, characterised in that the proportion of fibres in the first thermoplastics material makes up more than 10% by weight.

8. A material according to one of Claims 1 to 2, characterised in that the proportion of a first material which wets the fibres well is between 10 and 40% of the matrix material.

9. A material according to one of Claims 1 to 2, characterised in that the first material is polypropylene and the second material is high-quality polyamide, e.g. PA-66, wherein the proportion of PP is between 10 and 40% and the proportion of PA is accordingly between 60 and 90%.

10. A material according to one of Claims 1 to 2., characterised in that it contains a compatibility component which increases the bonding between the various matrix materials and/or the miscibility thereof.

11. A method for the production of long-fibre reinforced thermoplastics, wherein the fibres are impregnated with a first thermoplastics material, characterised in that the fibres which are already impregnated are encased again, or extruded, or mixed with a second thermoplastics material which is different from the first material.

12. A method according to Claim 11, characterised in that the length of the fibres is on average at least 1 mm, preferably at least 3 or more than 6 mm.

13. A method according to one of Claims 11 or 12, characterised in that following impregnation of the fibres with the first thermoplastics material and following a shaping- and solidification step, the material is broken up into smaller sections, the length of which corresponds in magnitude to the average length of the fibres, wherein these broken up sections are mixed with the second material, possibly heated, and together subjected to a shaping process.

14. A method according to Claim 13, characterised in that the shaping takes place by extrusion, blow moulding, or injection moulding.

15. A method according to Claim 13 characterised in that following the mixing of the first, fibre reinforced material with the second material the mixture is increased to, or just slightly above, the melting point of the higher melting substance for a short time only.

WO 01/02471
PCT/DE00/01928

A Long-fibre Reinforced Thermoplastics Material and A Method for Production of Same

The present invention relates to a long-fibre reinforced thermoplastics material and a method for the production of long-fibre reinforced thermoplastics, wherein the fibres are impregnated with a first thermoplastics material.

Corresponding materials and methods for their production have long since been known.

In this domain, the term, "long-fibres" generally denotes fibres of at least 1 mm in length, and preferably in the order of 5 mm or above. Such fibre materials, also called composite materials, have meanwhile been used in a multiplicity of ways in the domain of mechanical structural members where low weight, and, for example, high mechanical strength, electrical insulating property, or a low or high thermal conductivity should be combined together. For example, glass fibre- or carbon fibre-reinforced plastics are generally known for use with components subjected to both light and heavy mechanical loads, e.g. aircraft carrier surfaces, ships' hulls, golf club shafts, technical injection moulded components, and the like.

Long-fibre reinforced, thermoplastics materials are often also made in the form of semi-finished or half-finished goods, by a thermoplastic being mixed with corresponding fibres, for example, or by fibres being impregnated with a thermoplastics plastics material, whereupon the material produced in this way is then broken into pellets or a granulate which is then used as a raw material for the production of larger sized components. To that end, the pellets or granulate particles are melted, cast into a mould, or applied to surfaces, and combined together in this way.

However, the combinations of materials which have been available hitherto for these long-fibre reinforced thermoplastics have been relatively limited. This is connected, amongst other things, with the fact that certain fibres cannot be impregnated with any thermoplastics plastics material without further ado, so that the plastics material adheres to the fibres only very poorly.

something which is however an important requirement for the production of the desired combined properties of such composite materials. In this respect, the long-fibres should ensure a relatively high degree of tensile strength, whilst, on the other hand, the thermoplastics plastics material contributes advantageous shaping capability, elasticity and other desirable properties, e.g. resistance to corrosion, resistance to temperatures, and general chemical resistivity.

Some properties, e.g. a good surface, can however only be produced with very great difficulty with conventional long-fibre reinforced thermoplastics, and generally require bonding with additional layers of material which produce good surfaces.

The chemical resistivity and resistance to temperature of these thermoplastics which have proven their worth hitherto for the impregnation of long-fibres in most cases leave much to be desired.

In the face of this prior art, the aim of the present invention is to create a long-fibre reinforced thermoplastics material and a method for the production of same, which offers a considerably broader possibility for variation in respect of the mechanical, other physical, chemical and electrical properties attainable, than has been the case with previously known thermoplastics, long-fibre reinforced materials.

With respect to the long-fibre reinforced thermoplastics material itself, the problem forming the basis of the invention is solved in that the matrix of the material consists of at least two different thermoplastics, wherein the fibres are wetted essentially by only one of the two thermoplastics materials.

This means that preferably at least 80% of the fibres, or fibre surfaces, are wetted with the first of the two thermoplastics materials.

This is advantageous in that one operational step, namely mixing or "blending" in an extruder, or similar machine, is abandoned.

In this way, it is possible to impregnate, or mix, the fibres with a first thermoplastics material which has a good wetting capability and impregnation capability for the fibres in question. The second thermoplastics material can then, if necessary, be selected with a view to the physical or chemical properties desired for the end product. For example, the second thermoplastics

material can be one which has a high resistance to temperature, a greater compressive strength, or, generally, mechanical strength, a better electrical insulation capability, or, optionally, also conductivity, or better resistance to certain chemicals. Depending upon the proportion of the second thermoplastics material, its advantageous properties can then be decisive for the end product, whereas the fibres impregnated with the first thermoplastics material contribute to a very good tensile strength and thus a high mechanical loading capacity for the material. As far as the second thermoplastics material is concerned, it is possible to select one which may have a very poor impregnation capability or wetting capability for the fibres, but which can combine easily and relatively well with the first thermoplastics material. The result is then a material which combines the advantageous properties of long-fibre reinforcement with those of the second thermoplastics material, wherein the first thermoplastics material essentially only forms the binding member between the fibres and the second thermoplastics material.

It will be appreciated that consequently the material which can be considered primarily for the second thermoplastics material is one which has a poor impregnation capability or wetting capability for the fibres present in the material. If the impregnation capability or wetting capability were as good as, or even better than, the first thermoplastics material, then the fibres could also be encased or coated directly with the second material, and there would be no need to combine two thermoplastics materials.

In any case, the special mixture, which is homogeneous to a greater or lesser extent, of two thermoplastics materials can also have new advantageous properties which neither of the two materials per se has, and so basically the joint use of two thermoplastics materials as a matrix for long-fibres should be encompassed by the basic concept of the present invention, even if each of the individual materials per se has a good wetting- and impregnation capability for the fibres.

The fibres contained in the material are, in particular, glass-, carbon-, aramide- or natural fibres, wherein the latter include materials like flax, hemp or jute, for example, and wherein mixtures of all the afore-mentioned fibre materials can also be used.

Clearly, in view of the foregoing statements, it is expedient if at least one of the thermoplastics materials, referred to here as the "first" thermoplastics material, is a material which wets the fibres well, wherein the material is preferably selected from the group consisting of polypropylene, polyamide (polyamide 6, polyamide 66, polyamide 12, polyamide 46),

polyethylene, acrylonitrile/butadiene/styrene copolymers, polyphenylene sulphide, polystyrene, and polyether-ether ketone.

Advantageous properties of the material are also obtained if the, at least two, thermoplastics materials contained in the material are poorly miscible, or immiscible, and form an inhomogeneous mixture. Therein, it will be appreciated that the inhomogeneities should be relatively low, i.e. the sizes of inhomogeneous areas should be less than the typical length of the fibres. In this way, it is possible for the fibres which are wetted well by each respective one of the materials to bridge inhomogeneous areas in which the respective other thermoplastics material with a poor wetting capability substantially prevails. In this way, the advantageous properties provided by the tensile strength of the fibres are maintained, whilst, at the same time, the advantageous properties of the thermoplastics material which does not combine as well with the fibres are maintained in the material. In order to obtain a favourable ratio between the fibres which contribute to a first part of the desired properties of the material, and the second thermoplastics material which is intended to provide the rest of the advantageous properties, a variant of the invention is preferred, wherein the proportion of a first material which wets the fibres well makes up between 10 and 40% of the matrix material.

In a preferred embodiment of the invention, it is provided that the first material is polypropylene and the second material is a high-quality polyamide, such as PA66, for example, wherein the polypropylene proportion is between 10 and 40% and the PA-proportion is accordingly between 60 and 90%.

It can also be expedient if the material contains a compatibility component which increases the bonding between the various matrix materials and/or their miscibility. In this way, a more favourable bonding of the two poorly miscible materials is obtained, and thus greater homogeneity, so that even relatively short fibres in the region of between 1 and 5 mm in length can be used which bridge the correspondingly small inhomogeneous areas without further ado.

With respect to the method for the production of long-fibre reinforced thermoplastics, wherein the fibres are impregnated with a first thermoplastics material, the problem which solves the basis of the invention is solved in that the fibres which have already been impregnated are impregnated again, or mixed, or encased, with a second thermoplastics material which is different from the first material.

This method permits combination of the properties of fibres with thermoplastics materials (which are not very suitable per se for direct bonding), without a working step in which the thermoplastics are mixed together being necessary.

Expediently, the length of the fibres to be impregnated is preferably at least 3, or particularly preferably, more than 6 mm. The fibres can be supplied in the form of a skein of fibres of essentially longitudinal orientation, but also in the form of a fibre matting of fibres matted together, or also simply in the form of a fibre mixture of randomly oriented fibres. In one variant of the method according to the invention, the fibres are initially extruded onto, or encased around, the first thermoplastics material, and following solidification of the thermoplastics material, possibly also a shaping step in order to extrude all of the material, e.g. in a skein of constant cross-section, it can then be impregnated again as a skein with the second thermoplastics material. However, in most applications, an embodiment of the production process is preferred, wherein following solidification and possible shaping the material occurring (initially in the form of a skein) is broken up into smaller sections, wherein the length of those sections corresponds at least in magnitude to the average length of the fibres, in order not to shorten the fibres present unnecessarily. However, if the fibres are particularly long, e.g. far greater than 6 mm, e.g. 25 mm, or are more or less continuous fibres, the sections into which the skein formed with the first thermoplastics material is broken up can also be shorter than the average fibre length. These broken up sections are then mixed with the second material, possibly with heating, and the mixed material is then subjected to a shaping operation.

A shaping process such as this generally takes place by extrusion, blow moulding or injection moulding. With some mixtures of thermoplastics materials, it can be expedient, if, after the first fibre reinforced material has been mixed with the second material (in a state below the melting point of the two materials) that mixture is brought to the melting point, or slightly above the melting point of the faster melting substance, for a short time only. This can, admittedly, result in the mixture not being completely homogeneous. However, it is sufficient if the inhomogeneous areas are small in size in comparison with the fibres, i.e. if, for example, conversely, relatively small areas are present in the material which consist of only one or the other of the thermoplastics materials, but if those areas have typical dimensions which are much less than the length of the fibres.

Further advantages, features and possible applications will become apparent from the following description of a preferred embodiment and the associated drawings, wherein:

Figure 1 shows, schematically, a method for the production of long-fibre reinforced thermoplastics with a matrix consisting of different thermoplastics, and

Figure 2 shows, schematically, a mixture consisting of a long-fibre reinforced thermoplastics material with a second matrix.

Figure 1, left, shows a fibre skein 1 which is guided through an extruder 2 by means of a feed device 3 for a first thermoplastics material, wherein the extruder 2 and the corresponding feed nozzle 3 are only shown roughly here, and the fibre skein 1 is likewise only shown schematically, and pass through the extruders 2 and 4 from left to right. After passing through the extruder 2 and feed nozzle 3, the fibre skein is impregnated, and will from now on be referred to as an impregnated fibre skein 11 which is guided through a second extruder 4 with a second feed nozzle 5, so that the fibre skein 11 impregnated with the first thermoplastics material is encased with the second matrix, or the second matrix is applied to the impregnated skein 11, and then emerges from the extruder 4 as a ready fibre skein 21. This procedure is recommended above all if it is supposed that the bond between the two thermoplastics is poor and does not form a homogeneous mixture of plastics materials, so that during the extrusion or encasement operation with the second matrix, an optimum bond can already be achieved between the two thermoplastics.

Figure 2 shows a long-fibre reinforced thermoplastics material with two matrices, which is produced somewhat differently from the thermoplastics material 21 shown schematically in Figure 1. In this case, following the first impregnation- and extrusion step, the long-fibre reinforced material 11' occurring, which consists only of the fibres and one first thermoplastic material, is broken down into pellets in the form of little rods, and these pellets, or little rods, consisting of the material 11' are then mixed with a second thermoplastics material 6, as shown schematically in Figure 2. This mixture can then be heated again, and possibly also be extruded in order to produce a thorough bond between the fibre reinforced first thermoplastics material 11' and the second matrix material 6. Therein, the final material occurring can indeed be inhomogeneous, and essentially contain the structure of Figure 2 (generally without any air gaps), wherein the fibres in the pellets 11' bridge the inhomogeneous areas so that the material appears overall to be homogeneous on the macroscopic scale, i.e. with dimensions which are

clearly greater than the length of the individual pellets 11', and has properties representing a combination of the properties of conventional fibre reinforced materials with properties of the second thermoplastics material, despite the fact that the second thermoplastics material considered per se does not bond, or bonds only poorly, with fibres, and therefore conventionally could not be produced as a long-fibre reinforced material.

Claims

1. A long-fibre reinforced thermoplastics material, characterised in that the matrix of the material consists of at least two different thermoplastics, wherein the fibres are wetted essentially by only one of the two thermoplastics materials.

2. A material according to Claim 1, characterised in that one of the substances of which the matrix consists has a poor impregnation capability or wetting capability with respect to the fibres which are present in the material.

3. A material according to Claim 1 or Claim 2, characterised in that the fibres which are contained in the material consist of glass-, carbon-, aramide- or natural fibres, e.g. flax, hemp or jute, or mixtures of the afore-mentioned fibre materials.

4. A material according to one of Claims 1 to 3, characterised in that it contains a material which wets the fibres well, and which is selected from the group consisting of polypropylene, polyamide (polyamide 6, polyamide 66, polyamide 12, polyamide 46), polyethylene, acrylonitrile/butadiene/styrene-copolymers, polyphenylsulphide, polystyrene and polyether-ether ketone.

5. A material according to one of Claims 1 to 4, characterised in that the second thermoplastics substance does not wet the fibres directly or to a significant extent.

6. A material according to one of Claims 1 to 5, characterised in that the, at least two, thermoplastics materials contained therein are poorly miscible, or immiscible, and form an inhomogeneous mixture.

7. A material according to one of Claims 1 to 6, characterised in that the proportion of fibres in the first thermoplastics material makes up more than 10% by weight.

8. A material according to one of Claims 1 to 7, characterised in that the proportion of a first material which wets the fibres well is between 10 and 40% of the matrix material.

9. A material according to one of Claims 1 to 8, characterised in that the first material is polypropylene and the second material is high-quality polyamide, e.g. PA-66, wherein the proportion of PP is between 10 and 40% and the proportion of PA is accordingly between 60 and 90%.

10. A material according to one of Claims 1 to 9, characterised in that it contains a compatibility component which increases the bonding between the various matrix materials and/or the miscibility thereof.

11. A method for the production of long-fibre reinforced thermoplastics, wherein the fibres are impregnated with a first thermoplastics material, characterised in that the fibres which are already impregnated are encased again, or extruded, or mixed with a second thermoplastics material which is different from the first material.

12. A method according to Claim 11, characterised in that the length of the fibres is on average at least 1 mm, preferably at least 3 or more than 6 mm.

13. A method according to one of Claims 11 or 12, characterised in that following impregnation of the fibres with the first thermoplastics material and following a shaping- and solidification step, the material is broken up into smaller sections, the length of which corresponds in magnitude to the average length of the fibres, wherein these broken up sections are mixed with the second material, possibly heated, and together subjected to a shaping process.

14. A method according to Claim 13, characterised in that the shaping takes place by extrusion, blow moulding, or injection moulding.

15. A method according to Claim 13 or Claim 14, characterised in that following the mixing of the first, fibre reinforced material with the second material the mixture is increased to, or just slightly above, the melting point of the higher melting substance for a short time only.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
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(81) Bestimmungsstaaten *(national)*: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Bestimmungsstaaten *(regional)*: ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:

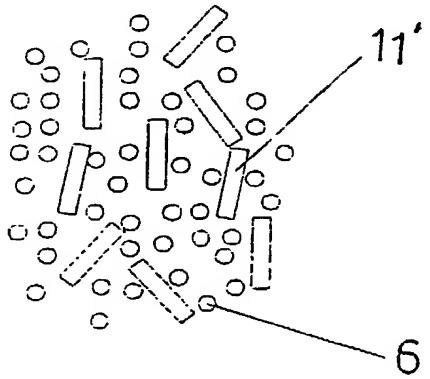
— *Mit internationalem Recherchenbericht*

— *Vor Ablauf der für Änderungen der Ansprüche geltenden Frist, Veröffentlichung wird wiederholt, falls Änderungen eintreffen.*

Zur Erklärung der Zweibuchstaben-Codes, und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen

(54) Title: LONG FIBRE-REINFORCED THERMOPLASTIC MATERIAL AND METHOD FOR PRODUCING THE SAME

(54) Bezeichnung: LANGFASERVERSTÄRKTES THERMOPLASTISCHES MATERIAL UND VERFAHREN ZUM HERSTELLEN DESSELBEN



(57) Abstract: The invention relates to a long fibre-reinforced thermoplastic material and to a method for producing long fibre-reinforced thermoplastics. According to said method, the fibres are impregnated with a first thermoplastic material. Since the matrix of the material consists of at least two different thermoplastics, the fibres being essentially only wet by one of the two thermoplastic materials, the material is considerably more variable in terms of the mechanical and other physical, chemical and electrical properties that can be obtained than known thermoplastic, long fibre-reinforced materials.

(57) Zusammenfassung: Die vorliegende Erfindung betrifft ein langfaserverstärktes thermoplastisches Material und ein Verfahren zum Herstellen von langfaserverstärkten thermoplasten, bei welchem die Fasern mit einem ersten thermoplastischen Material imprägniert werden. Dadurch, daß die Matrix des Materials aus mindestens zwei verschiedenen Thermoplasten besteht, wobei die Fasern im wesentlichen nur von einem der beiden thermoplastischen Materialien benetzt sind, wird erreicht, daß das Material eine erhebliche breitere Variationsmöglichkeit in den erzielbaren mechanischen, sonstigen physikalischen, chemischen und elektrischen Eigenschaften bietet, als dies bei bisherigen bekannten thermoplastischen, langfaserverstärkten Materialien der Fall war.

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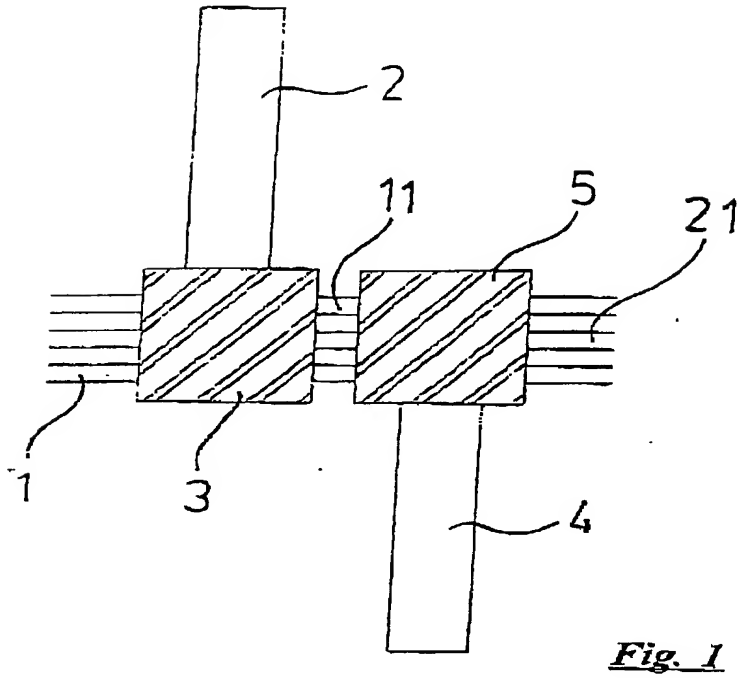

Fig. 1

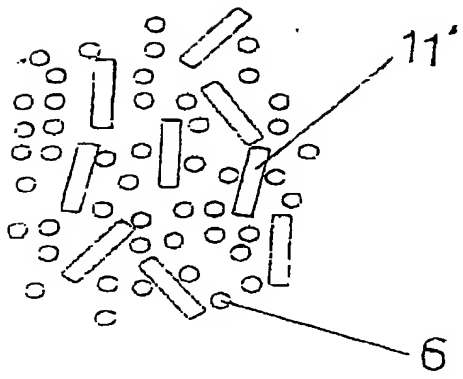

Fig. 2

FACT

Attorney Doc.: 343-01

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **A LONG-FIBRE REINFORCED THERMOPLASTICS MATERIAL AND A METHOD FOR PRODUCTION OF SAME**, the specification of which is attached hereto, which is based on International application PCT/DE00/01928 that was filed on June 9, 2000, which was based on German application No. 199 30 920.5, which was filed July 6, 1999.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
19930920.5 (Number)	Germany (Country)	06/07/1999 (Day/Month/Year Filed)	x Yes	— No
PCT/DE00/01928 (Number)	International (Country)	09/06/2000 (Day/Month/Year Filed)	x Yes	— No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date

of the application:

(Application Serial No.)	(Filing Date)	(Status) (patent, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status) (patent, pending, abandoned)

I hereby appoint the following attorneys and/or agents to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor signature Mathias Lindner Date April 10th, 2002